CMMI V1.2: What Has Changed and Why

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This article provides a view of what has been included – and not included – in Capability Maturity Model® Integration Version 1.2 (CMMI® V1.2) for CMMI users who are familiar with the products. CMMI V1.2 products, including CMMI for Development, V1.2 (the model), Standard CMMI Appraisal Method for Process Improvement (SCAMPI℠), V1.2 (the appraisal method), and Introduction to CMMI, V1.2 (the training), was released on August 25, 2006. I describe the major elements of change for each of these CMMI products. Draft V1.2 products were approved, piloted, and revised to ensure that the proposed changes actually improved the quality of the model, method, and training materials – and did no harm to existing improvement efforts and investments already made by those who used CMMI V1.1. I also seek to add some idea of why many of these changes were made.

For the CMMI product suite, the development of V1.2 has improved in three dimensions for each of the products that comprise the product suite. In one dimension, the emphasis was to clarify and simplify. In the opposite dimension, the effort was to position each of the products for potential expansion of the life cycle or expansion into new and related areas of interest. Overarching these dimensions was a growing recognition that all of the elements of the product suite could be strengthened to increase user confidence that appraisal results accurately reflect genuine process improvement.

What Are the Major Changes?

The CMMI framework is a repository of elements from which CMMI products are built. For the framework, V1.2 improvements resulted in a new architecture that allows the creation of new groupings of CMMI products called *constellations*. The word *constellation* refers to a set of model components, training materials, and appraisal documents in the CMMI framework that covers an area of interest such as development, services, or acquisition.

The result for the V1.2 model is that what once was CMMI V1.1 was improved and is now part of the development constellation. Therefore, the V1.2 constellation, called CMMI for Development, has two member models: CMMI for Development and CMMI for Development + Integrated Product and Process Development (IPPD). Both models have 22 process areas (PAs). I address the PAs more thoroughly further in the article.

For the appraisal method, SCAMPI V1.2, improvements focused on the clarification of terms that had proven problematic, such as the use of *face-to-face* interviews in organizations that are virtual or have multiple and distant sites. The appraisal team has addressed requests for more flexibility in breaking up appraisal activities (particularly across multiple sites) without compromising the confidence in appraisal results. Also added are new approaches to broaden sampling across the organizational unit being appraised to build confidence in process institutionalization. Although SCAMPI B and C methods (less stringent appraisal methods than the more well-known SCAMPI A method, which do not result in maturity level or capability level ratings) were developed under the existing V1.1 approach, the thought regarding having several classes of ratings to make up an appraisal family (SCAMPI As, Bs, and Cs) has been clarified in the V1.2 release.

The training approach for V1.2 also got a start under V1.1. The CMMI Steering Group's agreement to have a single introduction to CMMI course rather than separate ones for the two representations of the model (staged and continuous) was accomplished early in the V1.2 development schedule. Today, the single course has been updated to reflect the model changes described in more detail to come.

At the Software Engineering Institute (SEI), we are applying similar improvements to related courses, such as the Intermediate Concepts of CMMI course that we use to groom CMMI subject matter experts, including Introduction to CMMI instructors and SCAMPI lead appraisers. To date, we have offered the Intermediate Concepts of CMMI course for those leading improvement efforts in their organization, even if they do not wish to become instructors or lead appraisers. We are now pursuing the creation of a CMMI Deployment and Interpretation course that will better serve this audience.

A new approach that was instituted with V1.2 is an online upgrade course. While we provide the essential elements of change in the CMMI model, the SCAMPI Method Definition Document, and the Introduction to CMMI training in material provided free on the Web site, we have added both the refresher material and more advanced training material in CMMI V1.2 Upgrade Training for all those who must be able to apply CMMI principles on appraisals. A more detailed CMMI V1.2 Upgrade Training course is available to those who are instructors or lead appraisers or are along the path toward being one. The course for instructors and appraisers is part of the annual partner/fee structure. The upgrade course, available for everyone else is available on the SEI Web site where users can register and complete the upgrade course online for $175.

Now Tell Me What the Actual Changes Are

Simplification: Three Fewer PAs for the Model, With IPPD and Supplier Sourcing Simplified

More than 80 percent of the appraisals performed using CMMI V1.1 used models that did not extend beyond systems engineering and software engineering (i.e., they did not use models containing supplier sourcing or IPPD), despite the use of team-based development (where IPPD practices would be useful) and of complex, multi-company developments (where supplier sourcing practices would be useful). The CMMI development team felt that by consolidating the material in each of the areas, it could improve the use

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of these practices while simplifying CMMI models.

An approach suggested by many change requests received from CMMI users was to combine Integrated Supplier Management (ISM), which comprised the supplier sourcing addition, with Supplier Agreement Management (SAM), which was part of the software and systems engineering portion of the models. While ISM was designed for an environment in which process understanding is maintained across organizations and SAM was designed for an environment that would not necessarily require such understanding, the overlap between these two PAs was troubling.

The resulting change for V1.2 is that the informative material was strengthened in SAM about effective sourcing, and two specific practices were added to address the kind of enhanced visibility of supplier progress that ISM covered. Since one specific practice, *Analyze COTS* (commercial off-the-shelf), was refocused as informative material within SAM and sub-practices in Technical Solution (TS), the net increase for SAM is one additional specific practice.

The two new SAM-specific practices are the following:

- Monitor selected supplier processes.
- Evaluate selected supplier work products.

These two practices are added with the understanding that the process monitoring and work product evaluation opportunities will be as described in the established agreements with the project's suppliers. Not all agreements will allow close scrutiny by the project and not all products provided by suppliers will need that level of scrutiny to avoid system development risk.

When the development team first sought to address IPPD in CMMI, we placed many of the concurrent engineering (i.e., a non-linear approach to product design and engineering) concepts throughout the model. We then used two approaches to address team-based behaviors. In the case of the Integrated Project Management (IPM) PA, we added two goals that were team-centric and would only be used if the IPPD was selected. We then added two additional PAs to capture team-based thinking: Organizational Environment for Integration (OEI) and Integrated Teaming (IT).

For V1.2, we determined that the approach could be simplified if we added a goal to Organizational Process Development (OPD) to address the organizational commitment to IPPD and then consolidated the material from IT into IPM. This simpler approach has greatly reduced the number of practices and PAs that are unique to team-based development. IPPD will now be addressed with only one approach for expansion – the inclusion of one additional IPPD goal in OPD (to address the organizational behaviors) and a *single* goal in IPM (to address the project behaviors). These two goals, which replace the five IPPD goals in V1.1, are the following (revision shown in Figure 1):

- Enable IPPD management (in OPD).
- Apply IPPD principles (in IPM).

Simplification: Eliminating Common Features and Advanced Practices

A legacy from the Capability Maturity Model® for Software (SW-CMM®) was the use of *common features* as a method of describing the different roles that generic practices fulfill in assuring institutionalization of the model's intent across the organization. While this concept may be useful in training, it complicates model depiction. We felt it was time to move to a simpler approach of simply numbering the generic practices. Therefore, V1.2 models no longer contain common features as a way to organize the generic practices.

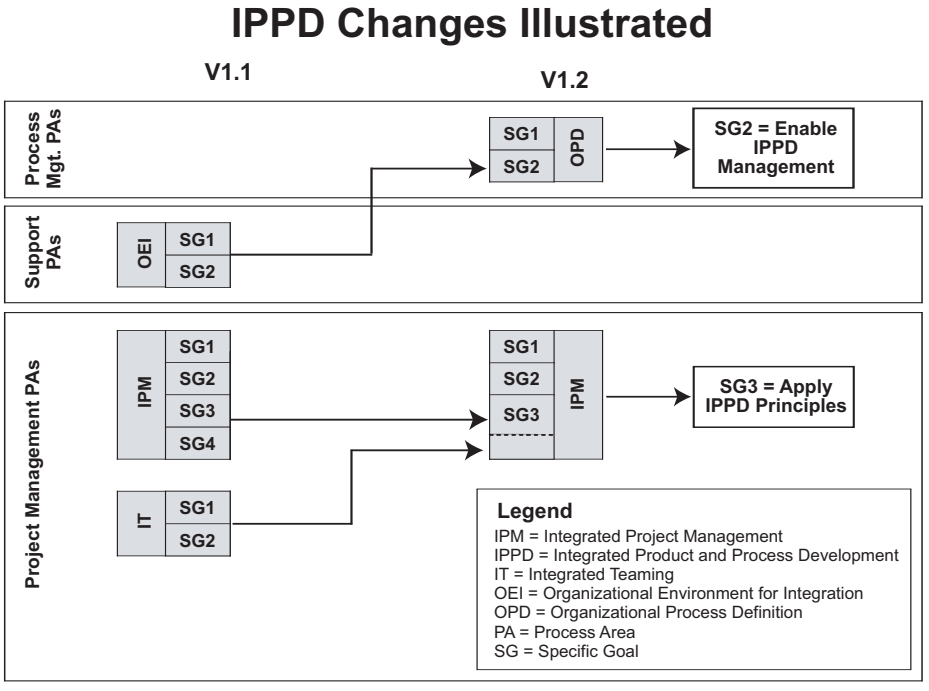
More difficult was resolving the legacy from the Systems Engineering Capability Model (SECM) Electronics Industries Alliance (EIA)-731, the advanced practices that we had placed in the engineering PAs. We felt that while the idea of advanced practices made sense, they were less valuable in the existing model structure because they added complexity without providing strong differentiation between base and advanced practices. Further, advanced practices seemed to complicate appraisals. Therefore, V1.2 models no longer contain advanced practices. All specific practices are now considered to be at capability level 1.

Expansion: Hardware Engineering Amplifications and Work Environment Coverage

A hardware engineering team was chartered with finding ways to ensure that CMMI adequately addressed the hardware aspects of product development that were sometimes perceived to be missing from earlier versions of CMMI. Much of this work is now reflected in additional hardware engineering examples throughout the model, sometimes within hardware engineering amplifications and sometimes in lists of examples representing multiple aspects of product development. This addition of examples resulted in a reduction in the total number of amplifications in the model.

We typically considered it better to cover product development examples together rather than seek to separate them into software examples, hardware examples, etc. Therefore, the additional hardware engineering material, when possible, was added as material that all would see as part of the development model, rather than an amplification that only some may read. The final result for V1.2 is that the hardware amplification (i.e., labeled *For Hardware Engineering*) were limited to only

Figure 1: *How IPPD Material Was Moved for V1.2*



six and the software amplification (i.e., labeled *For Software Engineering*) were reduced to only eight. An example of hardware amplification is found in Technical Solution, specific practice 2.1:

> **For Hardware Engineering:** Detailed design is focused on product development of electronic, mechanical, electro-optical, and other hardware products and their components. Electrical schematics and interconnection diagrams are developed, mechanical and optical assembly models are generated, and fabrication and assembly processes are developed.

Work that explored future focus areas such as security and safety resulted in a proposal to include a new PA in V1.2 that covered the work environment (i.e., a work environment PA was proposed). However, further investigation revealed that we could cover the basics of work environment material just as we had for data management by creating two practices to address the concept.

These two practices were added to the same PAs as the new IPPD-related goals – OPD and IPM. A practice in OPD expects organizational attentiveness to effective work environment practices, and IPM expects deployment of these practices to the individual projects. These two specific practices are the following:

- Establish work environment standards (in OPD).
- Establish the project's work environment (in IPM).

Not Applicable PAs

With the release of V1.2, the potential for maturity level variability has been significantly reduced. In both V1.0 and V1.1, we described in Chapter 6 that PAs could be determined to be not applicable for organizational process improvement. One of the heritage models, the SW-CMM, had always allowed Software Subcontract Management (SSM) to be considered *not applicable*. The CMMI equivalent, SAM, was highlighted in the Chapter 6 discussion as the example of a PA potentially considered *not applicable* in CMMI.

The number of organizations seeking to exclude this type of PA from their appraisals dropped from 58 percent with the SW-CMM to 20 percent with CMMI, but we knew that some organizations, particularly small software developers, had no critical suppliers so that an allowance for exclusion remained important. However, the model text did not identify this as the only acceptable PA for consideration. We had a few other PAs declared *not applicable* for various reasons, but our view was that continuing to accommodate these exclusions diminished the confidence in the benchmark associated with maturity level appraisal results. (Appraisals using the continuous approach and not seeking staged equivalence, of course, allow any of the options desired for process improvement without providing potentially misleading results.)

Version 1.2 addressed this issue in both the model and the method. The V1.2 model no longer discusses *not applicable* status. The needed procedures for the appraisal team's determination are now part of the SCAMPI Method Definition Document. We will rely on the appraisal team to determine, prior to the appraisal onsite, if the SAM practices are needed in the organizational unit being appraised or not. The appraisal disclosure statement will include a statement about the lack of suppliers needing management, if the team makes that determination.

Appraisals using the continuous approach ... allow any of the options desired for process improvement without providing potentially misleading results.

Appraisal Validity Period

The CMMI Steering Group has determined that some sense of *lifetime* needed to be defined for CMMI appraisals. After extended discussions, the Steering Group determined that a three-year validity period, similar to that established for ISO 9000:2000, would be the most reasonable length of time. (We have frequently mentioned that there are often other significant reasons to question the maintenance of process capability, such as reorganizations or mergers and acquisitions.)

So how will this approach be phased in? The first part is easy. All future appraisals, both V1.1 and V1.2, will be considered valid for three years from the date of completion, as noted on the appraisal disclosure statement. When two years have passed without a new appraisal covering the organization, the SEI will contact the sponsor of the two-year-old appraisal to remind them of the three-year validity rule. At the three-year-point, publicly available appraisals on the SEI Web site <http://sei.cmu.edu/pars/> will be removed.

But what about already performed appraisals? Here, the planned availability of V1.2 causes a need for flexibility, as we want to encourage a smooth transition to the improved version. We therefore will consider existing appraisals older than three years valid for a full year after the release of V1.2, done in August 2006. This plan allows time to plan and execute appraisals using the V1.2 product suite. Further, we will continue to recognize V1.1 appraisals through most of 2007 in case the concerns about change are greater than what we currently expect.

Although we no longer publish SW-CMM appraisal results, we felt it appropriate to establish a *validity period* for these as well. The choice in this case, since all recognized appraisals had to be completed by the *sunset* of December 2005, was to choose a single date: December 2007. This plan leaves CMM users with some flexibility – more than a year and a half – to make the transition to CMMI, and to use either V1.1 or V1.2.

Discipline Distinctions

With the first two releases of CMMI, it was important to recognize which disciplines the models covered (e.g., software engineering, systems engineering), along with recognizing the heritage of the improvement models for each of the disciplines (i.e., material from the three source models: the SW-CMM, EIA 731, and the Integrated Product Development-CMM). However, over the years, these distinctions have become less important, and the unifying engineering development processes have demonstrated synergies that go beyond the original source models. We were also asked by users and the CMMI Steering Group to simplify the material.

The increasing number of possible model variations (e.g., CMMI-SE, CMMI-SE/SW/IPPD, CMMI-SW/IPPD), and therefore printed models, to address the various combinations of engineering disciplines made movement in that direction undesirable. Instead, we added amplifications for hardware engineering examples, but chose not to call out another model variation in the model name. Nor are multiple model documents available for users to choose from. Instead, there is one integrated model document containing the best development practices.

Changes to CMMI Beyond CMMI for Development

As we began to consider future coverage of organizational process improvement, we sought to maintain the greatest possible commonality among all the models created from the CMMI common framework of best practices. Figure 2 depicts the desire for commonality and needed specificity. This approach provides a way to avoid any CMMI model to grow too large for effective use.

Based on the initial efforts to maximize commonality among CMMI models, 16 of the 22 PAs of CMMI V1.2 comprise the process improvement CMMI Model Foundation for the three areas of interest currently being pursued: development, acquisition, and services. The 16 PAs (in alphabetical order) are the following:

1. Causal Analysis and Resolution (CAR).
2. Configuration Management (CM).
3. Decision Analysis and Resolution (DAR).
4. Integrated Project Management (IPM).
5. Measurement and Analysis (MA).
6. Organizational Innovation and Deployment (OID).
7. OPD.
8. Organizational Process Focus (OPF).
9. Organizational Process Performance (OPP).
10. Organizational Training (OT).
11. Process and Product Quality Assurance (PPQA).
12. Project Monitoring and Control (PMC).
13. Project Planning (PP).
14. Quantitative Project Management (QPM).
15. Requirements Management (REQM).
16. Risk Management (RSKM).

Each constellation includes the common parts of the 16 PAs above, with additions unique to the area of interest covered, or shared across some, but not all, of the constellations.

We recognized that even with the CMMI Model Foundation, we needed to allow some flexibility. No flexibility is allowed, however, for the *required* (i.e., specific goals and generic goals) or *expected* (i.e., specific practices and generic practices) components of the 16 PAs that make up the model foundation. Additions to these PAs will be allowed, just as the IPPD addition is allowed (and encouraged) in the development constellation.

In the informative material, we allow a little more flexibility so that typical work products can be added or substituted to fit a process area in each constellation. The only other substitutions or deletions allowed within these 16 PAs will be the informative material judged specific to development. This occurs in the current model in subpractices, where development-specific explanations are often found. These statements may be tailored to the needs of the new constellation. These include informative paragraphs below sub-practices and generic practice elaborations.

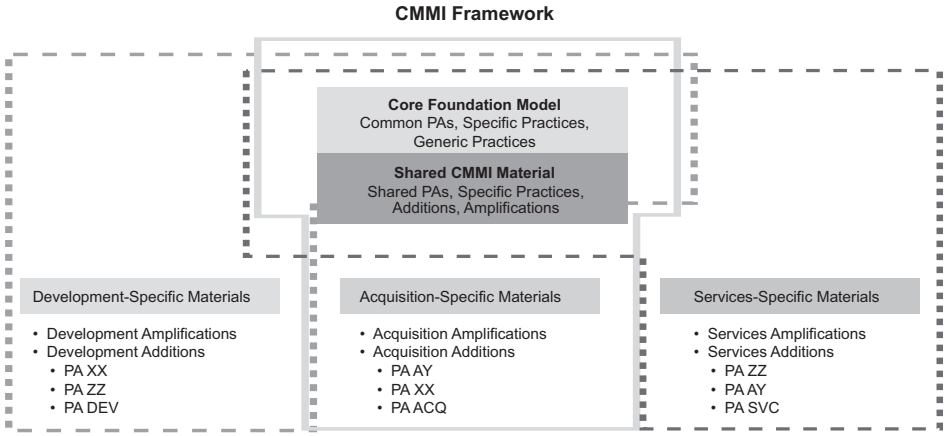


Figure 2: *How the CMMI Constellations Interact*

More tailoring is permitted to describe activities captured primarily in the engineering PAs of CMMI-DEV. While some of the constellations may share components with the engineering PAs in CMMI-DEV, the shared material may be arranged and grouped differently to meet the needs of the constellation's user base. If these adjustments change the PA in any significant way, the PA will be given a different name to avoid confusion in use, training, or appraisal. If two constellations find that a particular PA can be shared, then these PAs will be designed to capture that commonality as well. For example, the existing Verification or Validation PAs might be usable in one of the future models but not in others, so it would be shared across two constellations.

Summary

With V1.2, we sought to address a number of needed changes. Many of you, as CMMI users, gave us your thoughts on changes to improve CMMI. You may see, in the changes, something that you suggested. You may see areas changed in ways a bit differently than you suggested but similar in intent. And there may well be changes that you recommended, particularly expansions that we did not include this time.

Improvements will continue to be needed, and future updates to our constellations will continue to be made. We hope that this set of changes will simplify, add some needed coverage, and, most importantly, increase the confidence that the community appraisal results do represent faithfully the sincere efforts in process improvement that you and your peers have made in your organizations.◆

About the Author

Mike Phillips is the program manager for CMMI V1.2 at the SEI. Previously, he was responsible for transition enabling activities at the SEI. Phillips has authored technical reports, technical notes, CMMI columns, and various articles in addition to presenting CMMI material at conferences around the world. Prior to his retirement as a colonel from the Air Force, he managed the $36 billion development program for the B-2 in the B-2 System Program Office and commanded the 4950th Test Wing at Wright-Patterson AFB, OH. Phillips has a bachelor's degree in Astronautical Engineering from the Air Force Academy, a master's degree in Nuclear Engineering from Georgia Tech University, a master's degree in Systems Management from the University of Southern California, and a master's degree in International Affairs from Salve Regina College and the Naval War College.

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